

**S**HEARLINGS—sheepskins with the wool trimmed but not removed—have been used for many years as bedpads to lessen the development of decubitus ulcers (Fig. 1, right).<sup>1-4</sup> However, the use of shearlings for this purpose has been restricted because of the special care previously required to prevent shrinkage and stiffening of the leather when they were washed and dried.

Alum and chrome have been the conventional tanning agents for woolskins. However, an alum-tanned skin detans easily when it is washed. Chrome produces a more permanent tannage and the skins are launderable if sufficient amounts of chrome are used. For hospitals, Australian scientists have recommended shearlings tanned with much higher amounts of chrome and have described their use and laundering.<sup>3,5</sup>

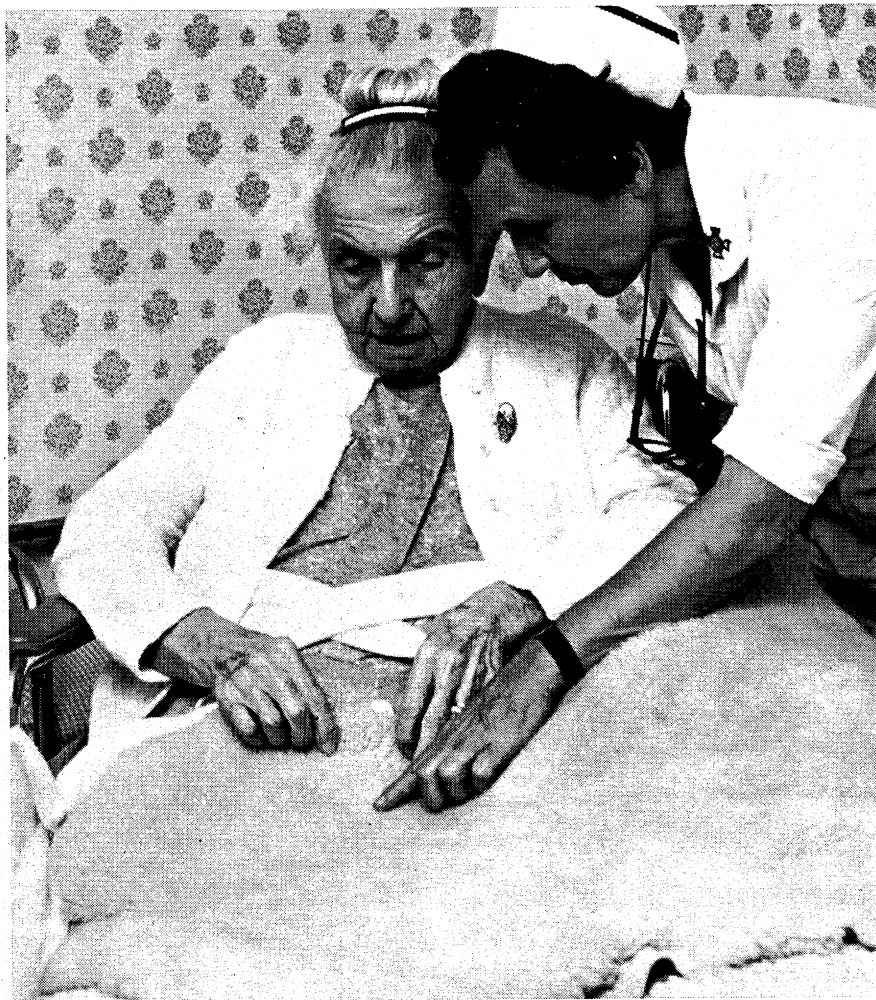
The tanning property of glutaraldehyde was discovered by Filachione and co-workers.<sup>6</sup> The resistance of glutaraldehyde-tanned leather to deterioration by warm soap solutions<sup>7</sup> suggested the use of this tanning agent for the production of "easy care" shearlings. Special tanning procedures employing a relatively large volume of solution and a minimum of agitation were developed to prevent matting and felting of the wool. The shearlings were first tanned with glutaraldehyde to make them readily washable and then retanned with chrome to increase resistance to hot water shrinkage.<sup>8</sup>

#### HOSPITAL SERVICE TEST

The promising results obtained with glutaraldehyde-tanned shearlings in laboratory tests and in a preliminary hospital trial led to a decision to conduct a large scale hospital service test.

To provide the large number of bedpads required for the hospital test, several packs of shearlings

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**FIGURE 1.** SHEARLINGS (woolskins) tanned with glutaraldehyde are easy to launder and have unique properties that make them excellent for preventing decubitus ulcers, especially in elderly patients.

## Launderable shearlings

Shearlings tanned with glutaraldehyde

showed superior performance in hospital testing

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were tanned with 15 per cent glutaraldehyde and with 10 per cent of this aldehyde in combination with 4 per cent, 8 per cent, 12 per cent and 20 per cent of chrome to provide increased resistance to hot water.

Two hundred thirty of the experimental shearlings were distributed to seven general hospitals, a

rehabilitation hospital, a nursing home, and an outpatient clinic of the Veterans Administration. Thirty-two commercial shearlings tanned with alum, chrome, or a combination of glutaraldehyde and chrome also were distributed for comparison. Several shearlings from each tannage were stored under ambient room conditions for

TABLE 1—HOSPITAL LAUNDERING, DISINFECTING, AND DRYING PROCEDURES FOR SHEARLINGS

Operation	Temperature (°F.)	Time (min.)	Compounds
Rinse	100	3	None
Wash	120	10	Detergent + disinfectant
Rinse	100	3	None
Rinse	100	3	None
Sour*	100	3	Commercial-sour
Spin dry			
Tumble dry	130 stack temperature		

\*Sour was used to reduce the alkalinity to near neutrality. Reprinted by permission.<sup>10</sup>

hardening of the leather. A disinfectant was used either during washing or in the final rinse. The shearlings were soured to a skin pH of near neutrality, spin-dried, and then tumble-dried at a stack temperature of not over 130°F. Alternatively, the shearlings were hung to air-dry. Excessive matting of the wool and overheating should be avoided.

Domestic-size washers and dryers were used by one hospital and at home by the veterans. The nursing home used a domestic-size washer/extractor but a large dryer.

One hospital sterilized the shearlings by exposing them to ethylene oxide after each laundering. However, ethylene oxide is expensive, and routine use of this gas has been reported to detan shearlings and shorten their useful life.<sup>9</sup>

Hospitals and nursing homes use a variety of disinfectants and disinfecting procedures to minimize the possibility of cross infection. Methods of disinfecting shearling bedpads as they are laundered in warm water are being studied by the Southern Research Institute, Birmingham, Ala., under a research contract with the United States Department of Agriculture. Scientists of the institute are contaminating shearlings with common bacteria and viruses and laundering them with different combinations and concentrations of detergents and disinfectants. To determine the relative effectiveness of the various treatments, the leather, the wool, and the final rinse water are being analyzed for bacteria and viral content. A recommended procedure for laundering and disinfecting glutaraldehyde-chrome-tanned shearlings is expected to be developed from this research.

#### RESULTS OF TEST

The effects of repeated use, laundering, and drying on the chemical and physical properties of the shearling bedpads for various periods of hospital service have been reported.<sup>10</sup> All of the shearling pads tanned with glutaraldehyde alone or in combination with various amounts of chrome were quite durable. Glutaraldehyde assisted in maintaining the shearlings in a soft, flexible condition after prolonged use whether or not



FIGURE 2. THE IMPROVED resistance to washing is shown by the glutaraldehyde-chrome-tanned shearling (right) which remained soft and flexible after 46 laundrerings in a hospital. The conventional alum-tanned pad (left) became hard and shrunken after only 5 washings.

use as controls. The bedpads were used during a three-year period under various clinical conditions, examined at regular intervals, and removed from service after various periods of use for laboratory evaluation.

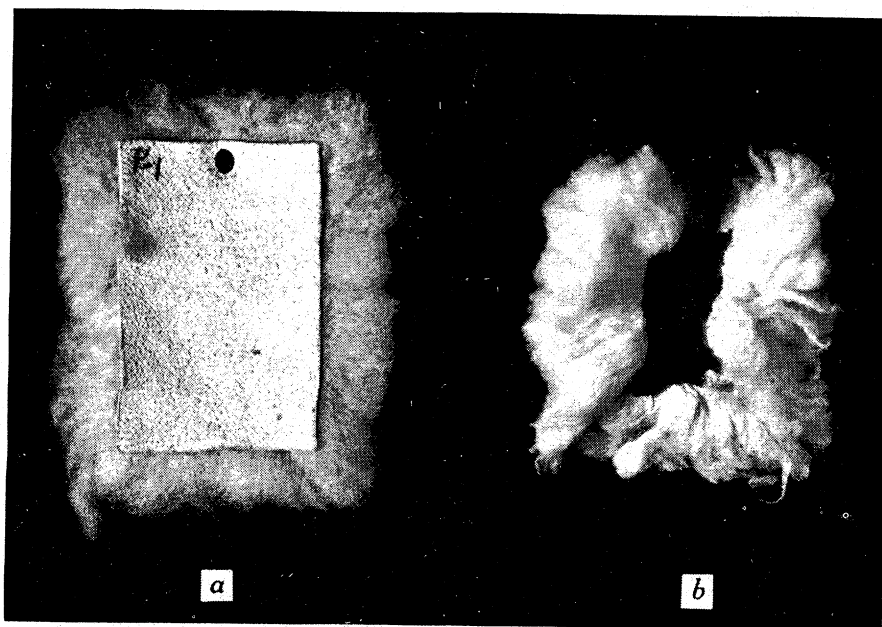
Recommended laundering, dis-

infecting, and drying procedures are presented in Table 1, above. An initial rinse was used if the bedpads were heavily soiled. The shearlings were washed with a mild soap or detergent at a temperature of not over 120°F. to prevent shrinkage of the wool or

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**FIGURE 3. TESTS SHOWING** the resistance of commercially tanned shearlings when exposed to an artificial perspiration solution at 70°C. (150°F.) for 48 hours. (a) The glutaraldehyde-chrome tannage remained soft and had an area loss of only 3 per cent, (b) the alum-tannage became hard and brittle and showed an area loss of 67 per cent. The original sample size of the leather before testing was 2 by 3 inches.

chrome was present. However, it was found advantageous to have sufficient chrome present to maintain the resistance of the leather to moist heat (shrink temperature) well above the washing-drying temperature range. This prevents damage to the leather.

A few pads became stiff or hard when the recommended laundering and/or drying temperatures were exceeded or when tanned with alum or small amounts of chrome. There was no apparent relation-

ship between stiffness and the number of launderings. Stiffness appeared to vary with the individual hospital. This is indicative of variations in procedure and the care and attention to details that each hospital was able to provide in laundering and drying the shearlings.

Shearlings tanned with alum or small amounts of chrome failed after a short time in service. Those tanned with high amounts of chrome had increased durability,

but their service life was not as long as that for pads containing glutaraldehyde and they became stiff sooner.

In these tests any moderate detanning action that could have been attributed to the ethylene oxide was overshadowed by changes in shrink temperature, stiffness, and tear strength caused by laundering and/or aging.

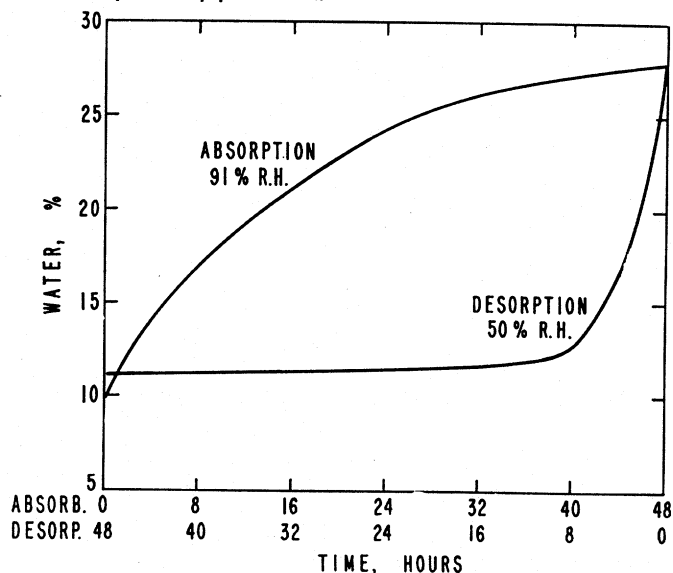
The launderable shearlings had excellent durability and were serviceable for as long as 28 months with as many as 54 launderings. This was considerably longer than the six-month service period and/or 10 launderings that one large hospital stated was economically feasible.

The experimental shearlings prepared for this evaluation were tanned with glutaraldehyde and then retanned with chrome. However, shearlings of equal durability can be obtained through tanning with glutaraldehyde and chrome simultaneously. Alternatively, the glutaraldehyde may be applied as a retannage to chrome-tanned skins.

#### ENHANCED PROPERTIES

Shearling bedpads produced by the use of glutaraldehyde in the tanning process give longer service and have greatly improved resistance to warm soap solutions and to perspiration. Figure 2, page 113, shows a glutaraldehyde-chrome-

**FIGURE 4. The rapid absorption and desorption of perspiration is important in the prevention of decubitus ulcers. A water vapor absorption-desorption curve of a glutaraldehyde-chrome-tanned shearling is shown above. (Reprinted by permission.)**



**FIGURE 5. WOOL is much more effective than synthetic materials in keeping the skin dry, as shown by the water vapor absorption of a glutaraldehyde-chrome-tanned shearling, polyurethane foam pad, and polyester fiber pad at 91 per cent relative humidity and 73°±1°F. (Reprinted by permission.)**

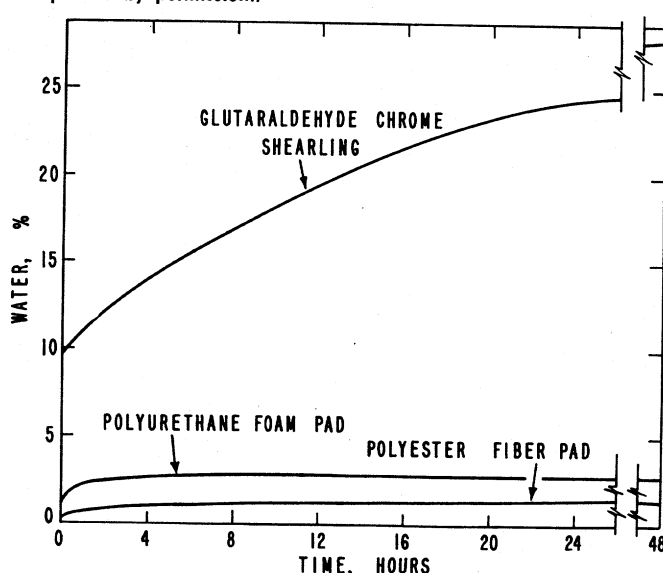




FIGURE 6. THE WOOL of a shearling bed-pad is fire-resistant. It will only char and will not ignite or burn when a lighted match or cigarette is dropped on it.

tanned shearling that remained soft and flexible after 46 launderings compared to an alum-tanned pad that became hard and shrunk after only five washings. Glutaraldehyde combines chemically with both the wool and the skin, and the glutaraldehyde-stabilized wool has increased stability to alkaline solutions.<sup>11,12</sup>

The resistance of commercially tanned shearlings to an artificial perspiration solution at 70°C. (159°F.) is shown in Figure 3, page 114. The leather of the glutaraldehyde-chrome-tanned shearling had an area loss of only 3 per cent and remained soft; that of the conventional alum-tanned pad had an area loss of 67 per cent and became hard and brittle.

The absorption of moisture by

the wool and its dissipation through the wool and leather are important properties of shearlings in the prevention and treatment of decubitus ulcers. The surface of the patient's skin is kept dry by absorption and removal of perspiration. Shearlings tanned with glutaraldehyde retain their moisture absorption property, absorbing up to 20 per cent of their weight in moisture and then dissipating it rapidly as shown in Figure 4, page 114.<sup>13</sup> Samples of shearlings and synthetic products were suspended in closed containers at a relative humidity of 91 per cent and a constant temperature of  $73 \pm 1^\circ\text{F}$ . Dissipation was determined at 50 per cent relative humidity and  $73 \pm 1^\circ\text{F}$ . The samples were weighed at intervals and the percentage of water was plotted against time. Water vapor was absorbed rapidly and continuously during the entire test period and then dissipated at a considerably greater rate, particularly during the first eight hours. The water vapor absorption rate and capacity of shearlings are many times greater than those of the synthetic polymeric materials, as shown in Figure 5, page 114.<sup>13</sup> The shearling absorbed water vapor rapidly from the start and after 48 hours had absorbed approximately 10 to 20 times as much as the synthetics. The shearling had a water content of 28 per cent, the polyurethane foam, 2.7 per cent, and the polyester fiber 1.4 per cent.

The glutaraldehyde-stabilized

wool also is resilient, distributes the weight of the patient evenly over a wide area, minimizes skin abrasion, allows air to circulate around the body, and is nontoxic.

Wool also is fire-resistant. It will char in an open flame but will not ignite or support combustion (Fig. 6, left) whereas some synthetic fibers will ignite and burn. ■

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